Linking development and growth to personalities in farmed rainbow trout (Oncorhynchus mykiss)

Individual variation in behavior and physiology has been described throughout the vertebrate phylum. Seemingly completely different behaviors can be related to each other and to physiological traits such as metabolism, hormone responses, and brain neurochemistry. Stable suits of behavioral traits which are consistent between situations and over time, are often termed personalities. Moreover, the term stress coping style is used when trait correlations include individual differences in physiological responses to a stressor. Personalities and stress coping styles may vary along a continuum, where the extremes have been categorized as active versus passive and proactive versus reactive, respectively. The behavioral profiles of the active/proactive extreme include being more bold, aggressive, and socially dominant. In contrast passive/reactive individuals are shy and socially subordinate. Physiologically traits of proactive individuals include higher metabolic rate and a less pronounced cortisol response to a stressor, compared to their reactive counterpart. Providing information on the correlation of traits expressed early in ontogeny could give valuable insight on the physiological processes involved in the organization of behavioral and physiological traits. However, most research on trait correlations is performed relatively late in ontogeny and the information about expression of personalities/stress coping styles during early development is meager. In salmonid fishes, the timing of emergence from spawning nests is related to behavioral and physiological traits. Generally, early emerging individuals exhibit active/proactive traits. Later emerging individuals, on the other hand, display passive/reactive characteristics. Coherent to this, there are studies suggesting that selection pressures early in ontogeny promote the co-existence of two energetically different strategies in salmonids. Early emerging fish have been demonstrated to have a higher metabolic rate compared to those individuals who emerge at a later stage during the emergence period.

There is a growing interest in the presence of individual trait variation in aquaculture, however, elusive results have been presented, and whether personalities/stress coping styles are present in domesticated fish remains debated. The emphasis of this PhD work was to investigate the relationship between individual variation in developmental rate during early ontogeny, personality/stress coping styles, and growth potential in farmed rainbow trout.

Two strains of rainbow trout selected for a low (LR) and high (HR) post stress plasma cortisol response have been shown to resemble proactive and reactive coping styles respectively. Results presented here showed that LR females produced large eggs that hatched into larvae with large yolk reserves. In comparison, HR females produced smaller eggs and offspring with smaller yolk reserves. Although no difference in larval growth and development was observed between the two lines a majority of the LR individuals emerged from artificial spawning nests early, prior to fully consuming their yolk reserves. In comparison a higher frequency of reactive HR fry emerged later after the yolk reserves had been fully depleted. This confirms proactive characteristics of early emerging fry. Moreover, the larger yolk in early emerging individuals was suggested to support a more energetically demanding proactive stress coping style during the initial social interaction and territory defense. This was further supported by newly emerged individuals with large yolk reserves showing a higher probability to obtain social dominance compared to individuals with smaller yolk reserves. Moreover, socially inexperienced individuals with large yolks, and a propensity for social dominance had lower brain concentrations of serotonin, suggesting a causative effect of this neurotransmitter on social dominance and aggression. Furthermore, the results demonstrated that farmed rainbow trout with an intermediate emergence time grew larger compared to both early and late emerging fry, suggesting that intermediate emerging individuals have a stress coping style lying in-between the proactive-reactive continuum, and that the behavioral and physiological traits of these fish are beneficial in aquaculture settings. Taken together, the results presented in this thesis demonstrate a relationship between traits expressed early in development and differences in personalities/stress coping styles and growth later in ontogeny of farmed rainbow trout.

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